Pesticide spraying Remote Guided Vehicle using IDE Arduino UNO

Pravin Dahalke*[1], Datta Wakshe[2], Swapnil Nawale[3], TRB Sanjay Kumar[4] & Atul Jade[5]

[1] -dpravin@mes.ac.in, [2]- dattawakshe@mes.ac.in, [3]- bswapnil@mes.ac.in,[4]-skumar@mes.ac.in, [5]-ajade@mes.ac.in , [1,2,3,4,5]- Assistant Professor, Department of Mechanical Engineering, Pillai HOC College of Engineering and Technology, Rasayani, Maharashtra, India.

Abstract:

Pesticide spraying is considered a very important activity in farming and from many years this activity has claimed a lot of lives. Under this project, we have fabricated a Remotely operated Vehicle to perform the task of spraying of pesticides in farms in order to reduce the number of deaths of farmers due to the poisoning effect of pesticides. Currently, there are drones available for spraying pesticides in farms but the cost of the drone is highly expensive and farmers can't afford the equipment. Its the need of hour to improve the productivity of agriculture land by reducing human laborers and introducing intelligent machines like IOT based RGV using the latest technologies. By using this RGV, the farmer himself can control the pesticide spraying with the help of small handheld devices like mobile phones or laptops through Internet of Things (IOT). The RGV can be controlled manually and automatically with the help of a combination of Arduino and Node MCU ESP8266 (Wi-Fi module) microcontroller. Along with manual control we can adjust the height of the sprayer nozzle.

Keywords: Pesticide spraying, farmer deaths, RGV, Arduino UNO

Introduction

Agriculture is considered as backbone of Indian Economy as about 25% population of India is directly attached to Farming. Farming involves a lot of activities from Preparation of the farming land till selling of farm products. Spraying pesticides is required to keep the corps safe from the insects. While spraying pesticides farmers inhale pesticides which is hazardous to their health. According to the Government of India in 2015 only, around 6800 people died due to accidental intake of pesticides. Thus to reduce these numbers, the act of spraying pesticide can be performed by RGV. A RGV is an electro-mechanical device that can be programmed to perform the task of pesticide spraying without human intervention during the actual spraying task. The RGV consists of Arduino Uno and Node MCU ESP8266 microcontroller. This RGV also consists of DC motors, wheels chassis, battery, router, ultrasonic sensor and various IC's. This remote controlled vehicle can be controlled manually or automatically. User section communicates with the RGV by using the programming principle of Internet of Things (IOT). This can be implemented through Arduino IDE software, which is used for developing various projects under the internet of things.

The RGV consists of Arduino Uno and Node MCU ESP8266 microcontroller, DC motors, wheels chassis, battery, router, ultrasonic sensor and various IC's. The RGV can be operated

automatically or manually. User section sends signals to the remote guided vehicle by

* - Corrosponding Author

implementing the concept of Internet of Things (IOT). This can be achieved through Arduino IDE software also called as Arduino Integrated Development Environment (IDE) software which is a virtual object database or an object relational mapping.

Problem statement

India is an agricultural based country. Agriculture activity acts as the main income source of livelihood for more than 80% of the population of rural Indian. Around 50 farmers/farm laborers have died and nearly 800 have been hospitalized due to poisoning in vidarbha district. While spraying pesticides on the crops, farmers inhale some pesticide particles resulting hazardous to their healthIn market, there are devices such as drones are available for spraying pesticides on crops but they do not spray in proper proportion .Therefore there is a need for improvising the spraying of pesticides ultimately leads to better health of farm laborers.

Primary objective of this paper is to define better agriculture techniques to provide a profitable way in order to increase productivity of farms, also helping farmers in spraying, keeping in mind safety of farm laborers.

Subsidiary objectives are as follows:

1. To ensure better health of farm labourers.
2. To minimize the time of spraying pesticides.
3. To cover the maximum field area.
4. It must be easily operated by the user.
5. To spray the pesticides uniformly throughout the field

Image: Farmer Spraying Pesticide

Image: The Hindu : News on farmers death

Design Methodology

The system is basically divided into two important sections - First part is referred as user section and second important part is the robot section. The first part consists of a laptop or mobile device for the purpose of communication with the second part i.e. robot section. Hence a Laptop computer or a mobile phone will make the user section more handy and portable when compared to those that use a typical bulky computer system. There are various methods of communication between the User section and Robot End. Required signals can be transmitted

with the help of Radio Frequency technology or by using a Zigbee device (Zigbee is a wireless technology developed as an open global standard to facilitate system of low-cost, low-power internet of things networks which are wireless) or by using Bluetooth technology, but they have very limited range. We can bring all sections on the internet platform to avoid the low range problem and to communicate easily which is the basic principle of the internet of things. Arduino IDE software is a cross-platform application that can be written in C and C++ and here we can use it for connecting the RGV with the internet. Arduino Integrated Development Environment (IDE) software is a virtual object database or an object relational mapping (ORM), has application in the field of designing prototypes and developing Internet of Things applications. An integrated development environment is a software application package which consists of different options to device programmers for software applications and development. An IDE comes with inbuilt source code in editor mode, automation inbuilt tools and a special tool for identifying and removing errors from software called as debugger. Thus through this Arduino IDE software, we can send commands and can easily control the RGV.

In the Remote Guided Vehicle we are combining an Arduino and Node MCU ESP 8266 microcontroller placed on the main body structure of the robot, which is the supportive framework of the entire robotic vehicle. In this RGV, 100 RPM DC motors are coupled to the wheels below the vehicle chassis body. Each motor runs on 12V supply provided by means of an external battery source attached to the vehicle chassis. Node MCU(ESP8266) is interfaced with the DC motors through a relay driver. A relay driver is connected to each 12 V DC motor, Relay driver is nothing but an electro-magnetic switch which is used to turn ON/OFF a low voltage circuit. for two motors and they are used for amplification purposes. The microcontroller coded with Arduino IDE software in order to operate the robot to run in the programmed direction. This is the manual mode operation associated with it. Sensors such as ultrasonic sensors, Optical sensors can be used which are directly connected to the microcontroller in the particular Input/Output pins. Ultrasonic sensors work on the principle of echolocation which is used by Bats to catch their food and travel in the dark.

Disadvantages of the drone:

1. Equipment cost is too high and is not affordable by farm labourers.
2. Pesticides carrying capacity is low.
3. Affected by wind while spraying pesticides.
4. It is not user friendly.

Advantages of Remote Controlled RGV:

1. It is cost effective.
2. Not affected by wind as compared to drones.
3. Pesticide carrying capacity is more than a drone.
4. Maintenance is less than a drone.
5. Skilled operator is not required.

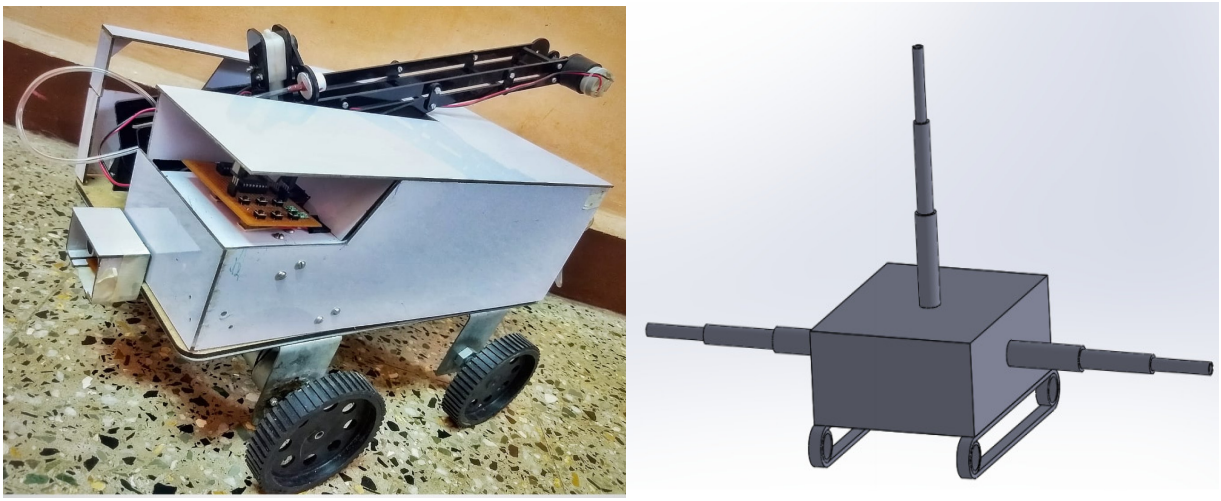

Image: Remote Operated Vehicle for Pesticide Spraying and CAD model

Component Details

 # Node MCU: NodeMCU is a low cost open source System On a Chip firmware for which open source programming designs and introduced by Espressif System. The name "NodeMCU" is a combination of "node" and “MCU” - microcontroller unit. Node MCU is a Wi-Fi SOC (System on a Chip) [6].

 # Arduino UNO: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason [6]. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package [6].

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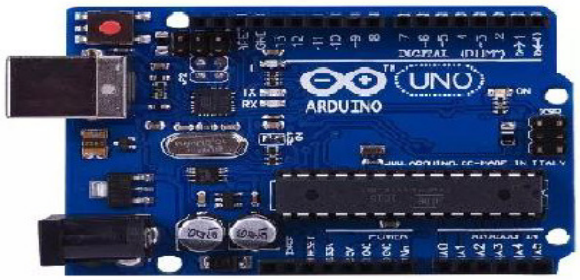


. Image: Node MCU Image: Arduino UNO

 # Ultrasonic Sensor: An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves and converts it into an electric signal. Distance can be measured by transmitting a sound wave at a particular predefined frequency and recording the time required to bounce back [6]. By recording the elapsed time between the sound wave being transmitted and the sound wave receiving back, it is possible to calculate the distance between the ultrasonic sensor and the object. Since it is known that sound travels through air at about 344 m/s (1129 feet/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total round-trip distance of the sound wave. Round-trip means that the sound wave traveled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object AND the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object) [6]. To find the distance to the object, simply divide the round-trip distance in half. It is important to understand that some objects might not be detected by ultrasonic sensors. This is because some objects are shaped or positioned in such a way that the sound wave bounces off the object, but are deflected away from the Ultrasonic sensor [6]. It is also possible for the object to be too small to reflect enough of the sound wave back to the sensor to be detected. Other objects can absorb the sound wave all together (cloth, carpeting, etc), which means that there is no way for the sensor to detect them accurately. These are important factors to consider when designing and programming a robot using an ultrasonic sensor. Following are some applications of ultrasonic sensors:

1. Anti-Collision Detection.
2. Obstacle Detection.
3. Contouring or Profiling.
4. Presence Detection.
5. Box Sorting using a Multi-Transducer System.
6. Easy Control of Trash Collection Vehicles.
7. Pallet Detection with Forklifts [6].

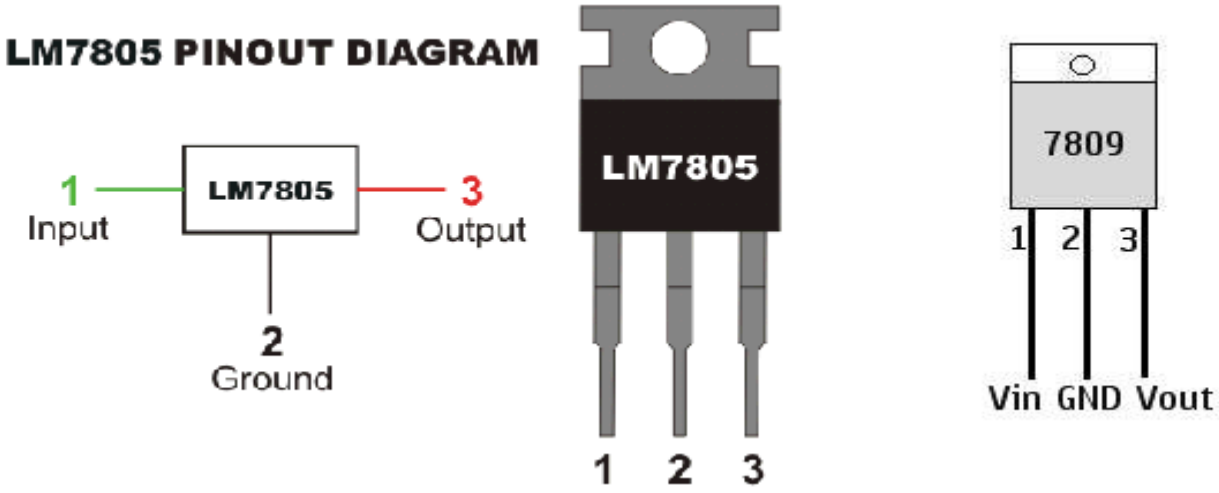
. Image: Ultrasonic Sensor Image: Driving Motors

 # Geared DC motor: A geared motor is a component whose mechanism adjusts the speed of the motor, leading them to operate at a certain speed. Centre Shaft Economy Series DC Motor is high quality low cost DC geared motor. It has steel gears and pinions to ensure longer life and better wear and tear properties [6]. The gears are fixed on spindles of steel (hardened) polished to a mirror finish. The output shaft rotates in a plastic bushing. A plastic ring covers the whole assembly. These Geared DC motors have the ability to run at lower speeds with higher torque, as the gearhead functions as a torque multiplier and can allow small motors to generate higher speeds [6]. Gearbox is sealed and lubricated with lithium grease which is maintenance free. The motor is coupled to the gearbox with the help of axle from inside. The motor gives variety of RPM values and torque range even though it runs at 12V and it runs smoothly from 4V to 12V [6].

 # Compressor (mini pump kpm27h): The compressor is used in this project to spray the water at different height level according to requirement. Compressor built up pressure in the tank and because of pressure built up water will spray through the nozzle.KPM27H Mini Diaphragm Type Air Pump. It requires 12V and 300mA. It develops 350mmHG pressure.

 # L293D motor driver IC: L293D is a typical Motor driver or Motor Driver IC which allows DC motors to drive in either direction.L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction [6].

 # Voltage regulator IC (7805 & 7809): 7805 and 7809 is a voltage regulator integrated circuit. It is a member of the 78xx series of fixed linear voltage regulator Ics [6]. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value [6].



. Image: Pin Diagram 7805 and 7809

Working

We have divided the working of our project in two parts because we use Node MCU(Wi-Fi module) and it doesn't have enough input pins, so for the remaining working systems we used Arduino UNO microcontroller.

Procedure:

Step 1: Set the position of Arm using switches.

Step 2: Adjust the position of sprayer using switches.

Step 3: Switch on the sprayer rotation motor.

Step 4: Open Browser on client (PC/Mobile) Enter the IP Address of Server (Node MCU) in client (PC/Mobile) to Open webpage.

Step 5: Send any remote control command (stop/front/back/right/left) to NODE MCU to control motors.

Step 6: send command of pump (ON/OFF) to Node MCU it will ON /OFF PUMP.

Step 7: Ultrasonic sensor measure the distance and send to node MCU

We have set here 50 cm distances, within 50cm of any obstacle, detect the controller and send notification to the web page. Directly stop the vehicle. To avoid any accident and vehicle automatic start after removing obstacles. And Node MCU again sends notification as "Obstacle Not Detected"

Future scope and Conclusion

Future consideration: Further analysis can be focused on a raspberry pi microcontroller which is very effective and efficient in use instead of the ongoing Arduino and Node MCU. Solar cells can be used to charge the battery while the RGV is on its work field. Other synthetic materials can be used to reduce the size of the RGV. Camera can be used at the front of the RGV for better visual during the operation. PCB can be used instead of VERO board. Modular (interchangeable) wheels or crawlers can be used according to field surface.

Conclusion: According to the requirements the farmer's health issues were neglected while spraying pesticides on the crops, hence a RGV has brought into consideration keeping in mind safety of the farm laborers. Literature review gave ideas regarding important aspects of the design of the components. The market survey conducted verified the availability of required components in the market. The design finalized may require some changes further according to the design testing. Thus an alternative to the most primitive method of spraying pesticides and fertilizers which will reduce the after effects caused in the process of spraying.

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